UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON
Helena, Montana

SMALL AREA HIGHWAY PROGRAM

Progress Report to the Montana Highway Department
for
Season Ending September 30, 1956

2 WD REPORT

JULY 1 - 1956 - SEPT 30, 1956

SUPPLEMENT TO 1ST REPORT
FINISHES YEAR TO SEPT 30, 1956

U. S. GEOLOGICAL SURVEY
408 FEDERAL BUILDING
HELENA, MONTANA
MARCH 1, 1957

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PROGRESS REPORT TO THE MONTANA HIGHWAY DEPARTMENT

for

SEASON ENDING SEPTEMBER 30, 1956

U. S. GEOLOGICAL SURVEY
408 FEDERAL BUILDING
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SMALL AREA HIGHWAY PROGRAM

Progress Report to the Montana Highway Department
for
Season Ending September 30, 1956

ABSTRACT

The report presents a brief summary of the basic data collected for the season ending September 30, 1956, under the provisions of the cooperative agreement with the Montana Highway Commission.

As a supplement to the Progress Report dated June 30, 1956, this report completes the season of 1956. All of the following annual reports will be on a seasonal basis ending September 30 of each year.

SMALL AREA HIGHWAY PROGRAM

Progress Report to the Montana Highway Department
for
Season ending September 30, 1956

INTRODUCTION

This second interim report has been prepared at the request of the Montana Highway Commission under the provisions of the cooperative agreement with that agency dated July 2, 1955. The first report was submitted June 30, 1956. By mutual consent, this annual progress report, and others prepared in the future, will cover the season ending September 30 each year, and will be submitted by about March 1.

In addition to the annual reports, Mr. L. W. Hargrove, hydrologist, Montana Highway Department, will be informed of outstanding flows as they occur. He will also be furnished from time to time information on the stage-discharge relations at the crest-stage gage sites or other information which may be currently useful to him.

The object of the six year program, initiated in 1955, is to collect data for a magnitude and frequency study of peak flows from small areas. The resulting magnitude and frequency analysis will be useful in the planning or design of small-stream drainage structures. The necessary information is being collected at 39 crest-stage or partial record stations, and 8 supplemental stations of which 4 have water-stage recorders (see fig. 1). It is planned to include the 8 supplemental stations in the final flood frequency analysis for their long

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CREST-STAGE GAGE PROGRAM

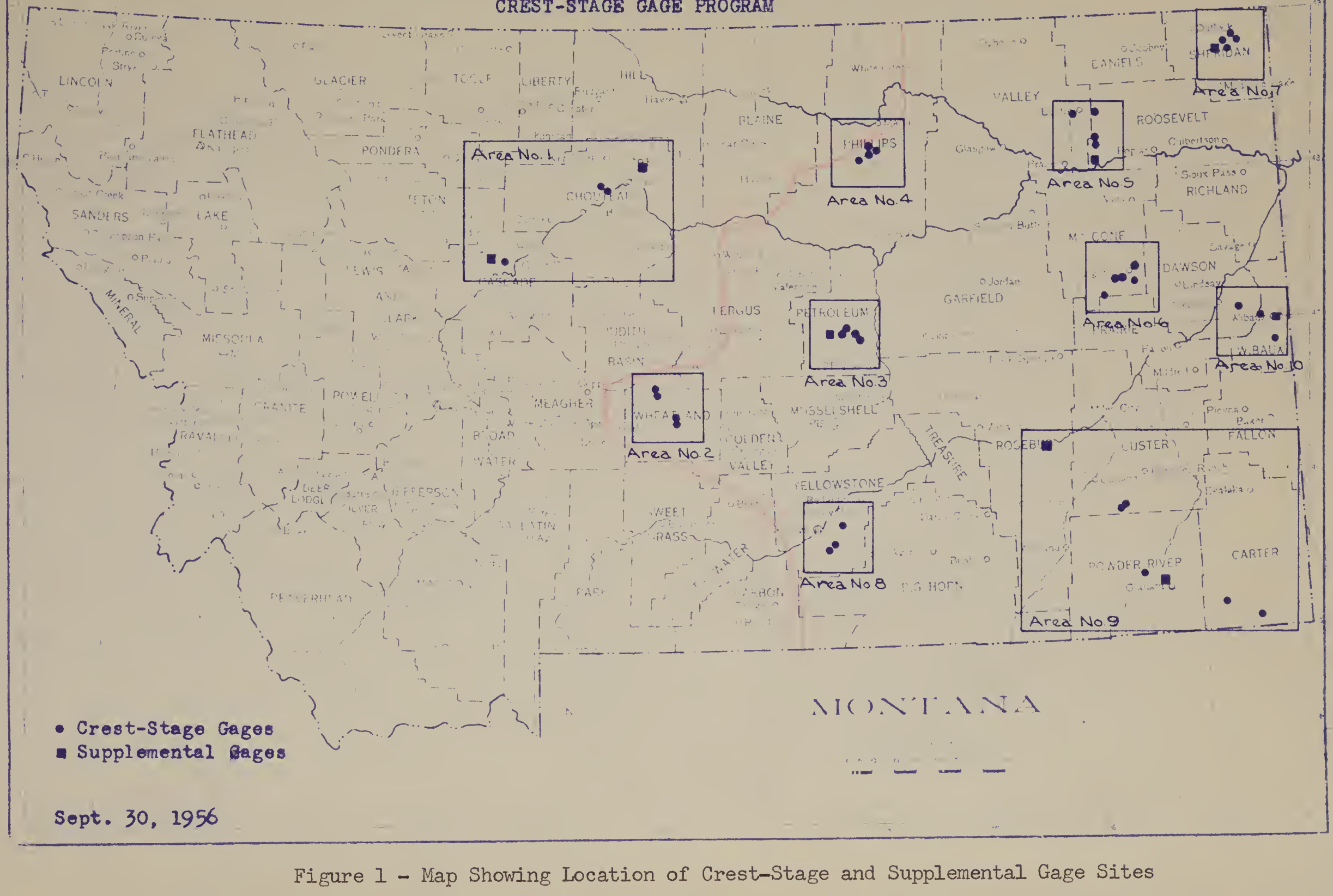

Figure 1 - Map Showing Location of Crest-Stage and Supplemental Gage Sites

record and correlative value with the partial record stations.

A trial magnitude and frequency study is being made in order to determine the suitability of one of many available techniques which may be of use in predicting future peak discharges.

Basic data were collected during past season at many of the sites shown in figure 1 and are summarized in this report (pages 6-8).

Field Progress

Since July 1, 1956, there were 59 occurrences of flow at the 39 partial-record sites. Twelve determinations of discharge were made; the remaining 47 observations of flow either were not considered large enough to warrant the determination of discharge by indirect means, or the ratings developed so far were considered adequate.

The period was fairly significant in that only two stations failed to have any flow, both on the same drainage basin: Box Elder Creek near Plentywood and Box Elder Creek at dam site, near Plentywood. Thirteen of 39 partial-record sites have been rated, 8 of them since July 1, 1956. The sites rated were in the Harlowton, Winnett, Malta, Billings and Broadus areas. A list of these 8 stations and the type of determination of discharge made at each is shown on page 18. The maximum flow at each of the thirteen rated stations during the period July 1, 1955 to Sept. 30, 1956 is shown on page 10.

Comparison of peak flows experienced in 1956 with long-term gaging stations indicates that the season ranks low in magnitude of

peak flows and about average in the number of events.

Discussion

Although the 1956 season was below normal in precipitation, it apparently did not affect the thunderstorm activity that produced runoff at the crest-stage gages. The small-area program has been in operation for two of the planned period of six years. The magnitude of the peaks experienced appears to be less than average. It is reasonable to expect that the continuation of the program for a six-year period should result in a worthwhile contribution to the determination of design floods for the smaller areas in the more arid portions of the state.

SUMMARY OF PROGRESS AND OBSERVATIONS OF PEAK FLOWS

Area No. 1 - Great Falls.--Three crest-stage gages in operation besides two supplemental regular gaging stations. One crest-stage gage (Choteau No. 3 near Virgelle) discontinued due to dam below gage causing backwater. No rating curves developed due to lack of significant flows.

Number of high-water marks found at the three crest-stage gages - 7

Number of times visited when no high-water marks were found- 18

Area No. 2 - Harlowton.--Four crest-stage gages in operation. Two gages were not rated due to lack of significant flow. One gage was provisionally rated on the basis of a slope-conveyance determination and a point of zero flow. Antelope Creek at Harlowton previously rated on the basis of two indirect determinations made prior to the present highway program, a float and a current meter measurement, and a point of zero flow.

Number of high-water marks found at rated gages- - - - - - 6

Number of high-water marks found at non-rated gages - - - - 4

Number of times visited when no HWM were found - - - - - - - 23

Area No. 3 - Winnett.--Four crest-stage gages in operation besides one supplemental gaging station. Three crest-stage gages were provisionally rated: One on the basis of a slope-conveyance determination and a point of zero flow; two on the basis of a culvert determination of flow on each from a survey of high-water marks, point of zero flow, and a computed discharge to help define the middle portion of each rating. One gage not rated due to lack of significant flow.

Number of high-water marks found at rated gages - - - - - - - 32

Number of high-water marks found at non-rated gages - - - - 4

Number of times visited when no marks were found - - - - - - 34

Area No. 4 - Malta.--Four crest-stage gages in operation. Three gages not rated due to lack of significant flow. One gage provisionally rated on the basis of a slope-area determination of flow and one current meter measurement of a low flow.

Number of high-water marks found at rated gages - - - - - - - 6

Number of high-water marks found at non-rated gages - - - - 10

Number of times visited when no marks were found - - - - - - 55

Area No. 5 - Wolf Point.--Four crest-stage gages in operation besides one supplemental gaging station. No stations were rated due to lack of significant flow.

Number of high-water marks found at non-rated gages - - - - -20

Number of times visited when no marks were found - - - - - - 35

Area No. 6 - Circle.--Four crest-stage gages in operation through September 1956, when a fairly large reservoir was found upstream from the Dry Ash Creek near Circle gage. This station was discontinued. Two new stations, McCone No. 1 near Brockway, and Tusler Creek near Brockway, were established. Two gages, East Fork Duck Creek near Brockway and McCune Creek near Circle, were provisionally rated by current meter measurements made at low and medium flows.

Number of high-water marks found at rated gages.- - - - - - - 17

Number of high-water marks found at non-rated gages - - - - - 18

Number of times visited when no marks were found - - - - - - 64

Area No. 7 - Plentywood.--Four crest-stage gages in operation besides one supplementary station. Three gages not rated due to lack of significant flow. One station fairly well rated on the basis of two slope-area and one contracted opening determinations of peak flows made prior to the start of the highway program. No high-water marks were found at two gages on Box Elder Creek; one of the gages being the one which has had a rating curve drawn.

Number of high-water marks found at rated gages - - - - - - - 0

Number of high-water marks found at non-rated gages - - - - - 5

Number of times visited when no marks were found - - - - - - 66

Area No. 8 - Billings.--Three crest-stage gages in operation. One gage is at a site previously operated and has a rating curve developed for it. One gage rated on the basis of one current-meter measurement, one estimate of flow, and a point of zero flow. The other gage not rated due to the lack of significant flow.

Number of high-water marks found at rated gages - - - - - - - 8

Number of high-water marks found at non-rated gages - - - - 15

Number of times visited when no marks were found - - - - - 15

Area No. 9 - Broadus.--Five crest-stage gages in operation, of which one is a water-stage recorder installation. Two supplemental recording stations also in operation. Two gages not rated due to lack of significant flow. The rating for the recorder gage was drawn on the basis of a determination of flow over a weir. Ratings were provisionally developed on the other two gages: One on the basis of a culvert determination of peak flow, the other on the basis of a slope-area determination of peak flow and an estimate of a low flow.

Number of high-water marks found at rated gages - - - - - - - 22

Number of high-water marks found at non-rated gages - - - - - 4

Number of times visited when no marks were found - - - - - - 40

Area No. 10 - Wibaux.--Three crest-stage gages in operation besides one supplemental station. No ratings developed due to lack of significant flow.

Number of high-water marks found at non-rated gages - - - - - 10

Number of times visited when no marks were found - - - - - - 60

SUMMARY OF FIELD WORK:	Fiscal Year 1955-56	July 1 to Sept. 30, 1956
Inspections of crest-stage gages	362	217
High-water marks found at time of inspection	175	59
Discharge measurements: Current meter	11	2
Indirect determinations	1	7
Estimates of flow	22	3

RAIN GAGE OBSERVERS

There are 33 rain gage observers, who are instructed to measure rainfall. During the winter, the observers measure the depths of snowfall, the accumulation of snow on the ground and the ground conditions.

Peak flows at rated crest-stage gages
during period July 1, 1955 to Sept. 30, 1956

Area No.	Station	Drainage Area	Probable date of Peak	Discharge cfs
2	Antelope Creek at Harlowton	73	6/26/56	800
2	Wheatland No. 2 near Harlowton	3 approx.	3/56	207
3	Petroleum No. 1 near Winnett	16.2	8/23/55	131
3	Petroleum No. 2 near Winnett	2.32	8/23/55	385
3	Petroleum No. 3 near Winnett	0.81	8/23/55	159
4	Disjardin Coulee near Malta	6 approx.	8/5/56	160
6	East Fork Duck Creek near Brockway	12.4	7/13/55	106
6	McCune Creek near Circle	28	7/12/55	170
8	Yellowstone No. 1 near Billings	2.58	6/22/56	89
8	Pryor Creek near Billings	425	3/56	800
9	Basin Creek near Volberg	9 approx.	8/27-28/56	800
9	Wolf Creek near Hammond	9.09	7/11/55	298
9	North Creek near Alzada	0.73	7/2/56	208

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